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OCR A Level Computer Science

H446 – Paper 2

3

Iteration

Unit 11
Programming techniques

PG ONLINE

Objectives

- Understand and use three different types of iterative statement:
  - **while** … **endwhile**
  - **do (**or **repeat) … until**
  - **for** … **next**

Iteration

- Iteration means repetition
- A sequence of instructions is repeated multiple times
- This is much more efficient than writing the instructions multiple times
- The number of repetitions needed may vary, and may not be known when writing the code
  - There are three types of loop: **while…endwhile**, **do… until**
    and **for .. next**

while … endwhile loop

- Using a while .. endwhile loop, the condition is tested upon entry to the loop
- It is possible that the instructions inside the loop might not be executed at all if the entry condition is not met

```
while condition x  ==
True
   execute statement a
   execute statement b
   etc....
endwhile
```

Iteration entry condition

- Trace through the pseudocode loop
  - What values will x take?
  - What will be the output?

```
x = 0
while x < 2
      x = x + 1
      print(x)
endwhile
print("The end")
```

x	Output
0	

- What would happen if the first statement was changed to x = 2 ?

Worksheet 3

- Complete **Questions 1** and **2** in **Task 1**

do.. until loop

- In a do. .until loop the statements in the loop are executed before the condition is evaluated
  - The statement will always be executed at least once
  - Complete the values for x and Output

```
x = 0
do
    x = x + 1
    print (x)
until x >= 2
print("The end")
```

x	Output
0	

- What would happen if the first statement was changed to x = 2 ?

Performing a range check

- A loop can be used to implement a range check
- The loop will continually prompt for input until a valid age between 12 and 18 is entered
- Work through the algorithm below with the data 10, 11,18 and 19. What will be the output?

```
do
      age = input("Enter age")
until age > 11 AND age <= 18
print("Age is", age)
```

An equivalent while … endwhile loop

- In Python the do…until loop is not supported
- An equivalent loop can be created using a while … endwhile loop
- Work through the algorithm below with the data 10, 11,18 and 19. What will be the output?

```
age = 0
while age < 12 OR age > 18
age = input("Enter age: ")
endwhile
Print ("Age is", age)
```

Infinite loop

- You may cause an infinite loop if you make a coding error
- What is the problem with this algorithm?

```
age = input(“Enter age”)
while age < 11 OR age > 18
    print (“Invalid data. Re-enter age”)
endwhile
print(“Valid data”)
```

Infinite loop

- Infinite loops are often used in 2D games
  - An “outer” while True… endwhile loop runs the game
  - A brief pause can be included to slow the loop down, so that a sprite x,y position can be updated about 25 times a second for smooth animation

```
while True
    updatePlayerPosition()
    checkForCollision()
    redraw()
endwhile
```

Infinite loops in control and data sensing applications

- Computer control and data sensing applications use infinite loops to gather data from sensors
  - A variety of sensors can control a number of output devices such as lights, buzzers and motors
  - After the setup code is run, the device enters an infinite loop to repeatedly check the value of the sensors

Worksheet 3

- Complete **Task 2**, **Questions 3** and **4**

for … next loop

- The for .. next loop is termed “definite iteration”, and is used to repeat a block of instructions a specified number of times
- The for … next loop uses a counter variable which
  is automatically incremented each time through
  the loop
- Optionally, a step value can be specified to make the counter increase or decrease by any integer

FOR .. NEXT loop

- What values will index and x take?

```
for index = 1 to 8
    x = (index ** 2) mod 3
    print(x)
next index
```

index	x
1	

Using a different increment

- The increment in a FOR loop can be varied
- What values will index and x take?

```
for index = 1 to 10 step 2
    x = (index ** 2) mod 3
print (x)
next index
```

index	x
1	

Stepping backwards

- The increment in a FOR loop can be negative
- What values will index and x take?

```
for index = 15 to 1 Step -3
    x = int(index/2)
print(x)
next index
```

index	x
15	

Using a while … endwhile loop as an alternative

- Are these loops logically equivalent?
- What number would you use in the for loop to get the same results as the while loop?

```
index = 1
while index < 4
    print(index)
    index = index + 1
endwhile
```

```
for index = 1 to ?
    print(index)
next index
```

- Outside the for loop, the variable index is undefined

Nested for … next loop

- It is possible to use nested for loops
  - These are particularly useful for looping through grids in two-dimensional arrays, which will be covered later
  - Calculate the values for i, j and Output

```
for i = 1 to 3
    for j = 1 to 2
        print(i + j)
    next j
next i
```

i	j	Output
1	1	
1	2	

Random number generator

- It is possible to use a built-in function to produce a random number
- In the example below, two players battle until one of them dies
  - Which player has a better chance of winning?

```
Player1 = 10
Player2 = 10
repeat
    Player1 = Player1 - random(1,6)
    Player2 = Player2 - random(1,4)
until Player1 <= 0 OR Player2 <= 0
```

Worksheet 3

- Now complete **Task 3**, **Questions 5** and **6**

Plenary

- There are three types of iteration:
  - Indefinite iteration with the condition tested at the start of
    the loop
  - Indefinite iteration with the condition tested at the end of
    the loop
  - Definite iteration where the loop is performed a given number of times
- Can you give an example of each?

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